

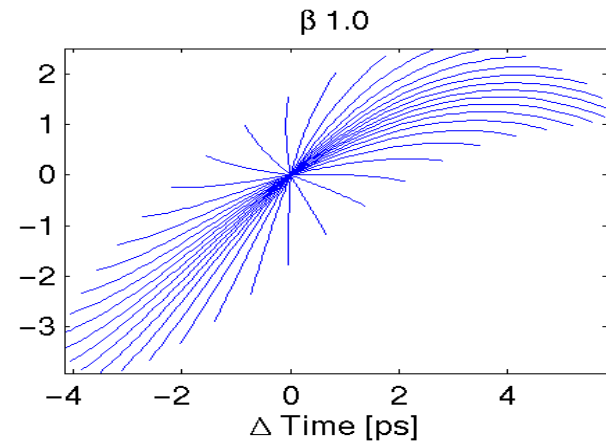
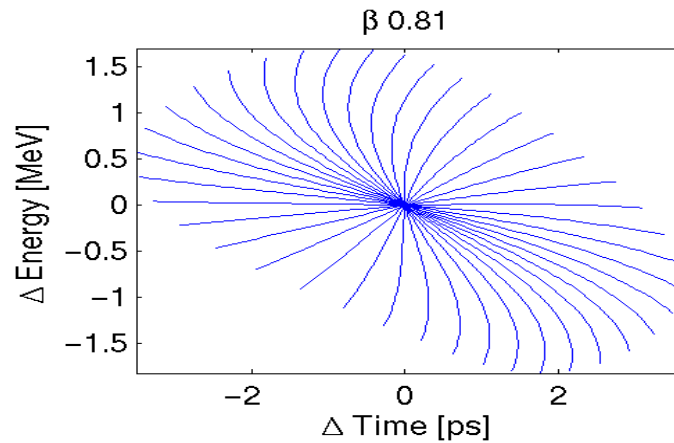
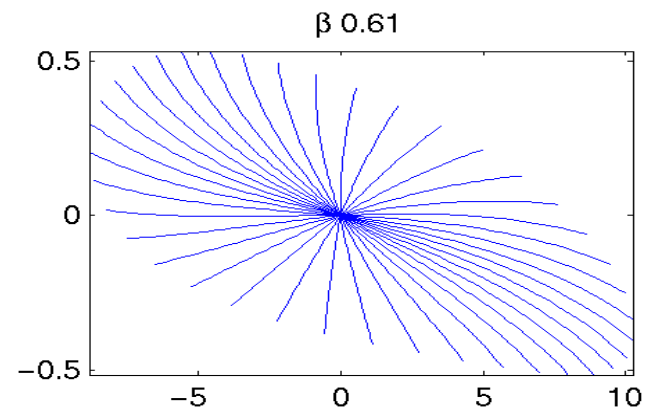
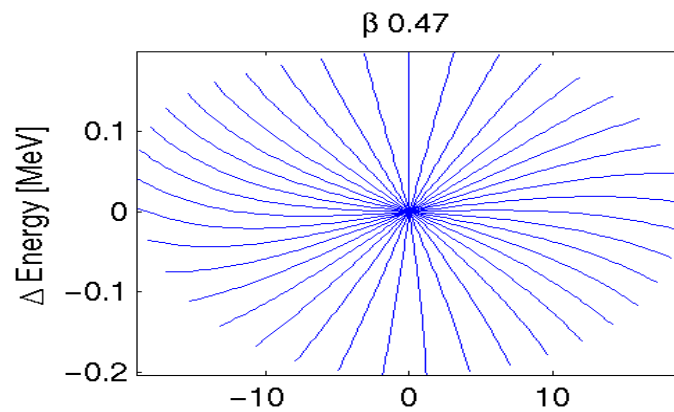
Phase Shifter Requirements

Markus Huening
Meeting on SCRF
Protondriver
Feb. 6th, 2004

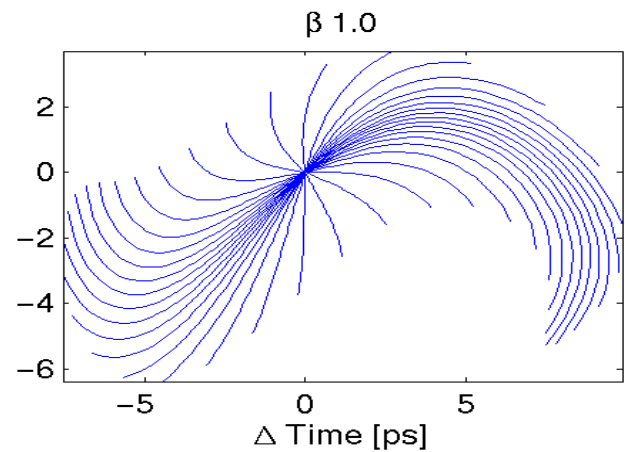
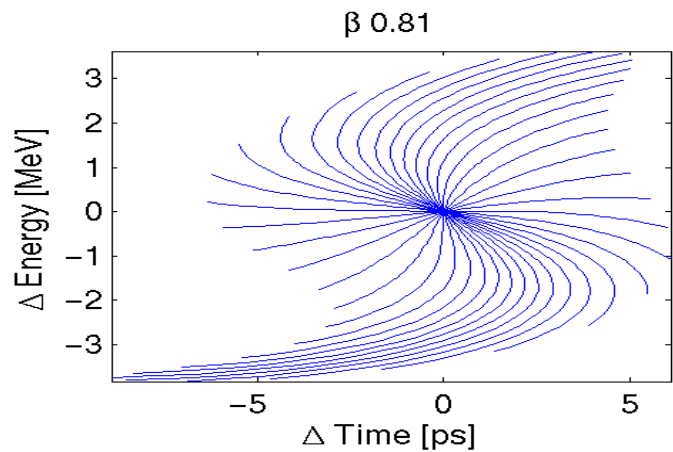
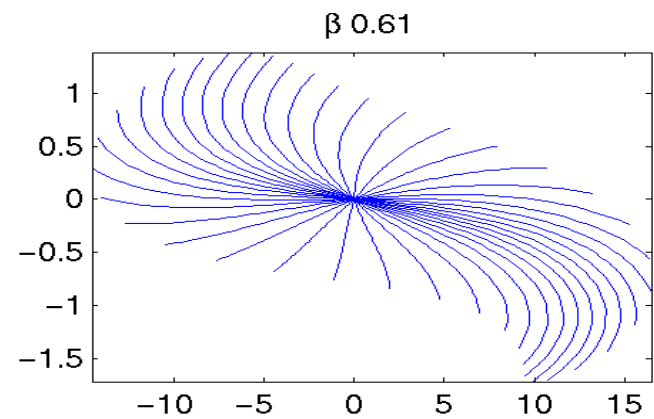
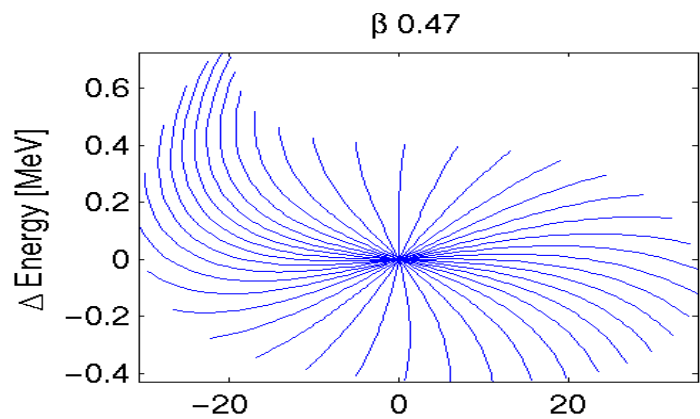
Conditions

- Beam loading different in each cavity
- Cavities detuned by Microphonics
- Cavities detuned by Lorentz-Force
- Arrival Phase dependend on upstream Fields
- Jitter of injected Beam (energy, phase, charge); coherent and incoherent

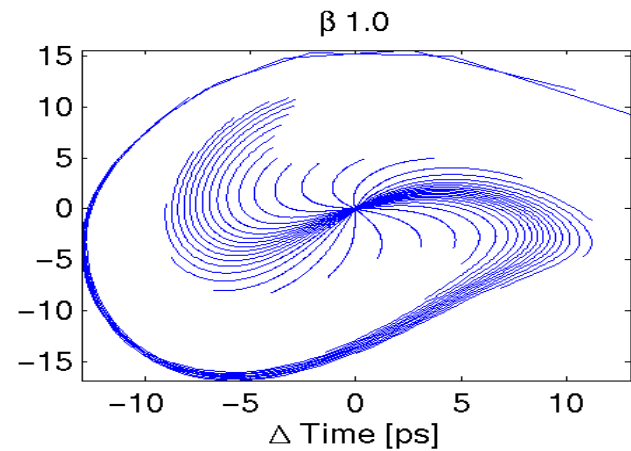
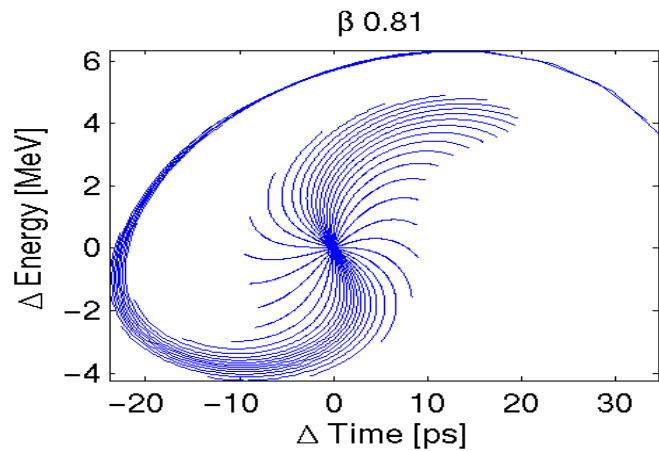
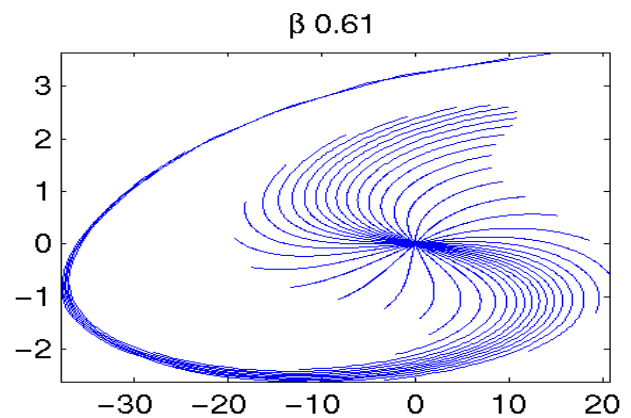
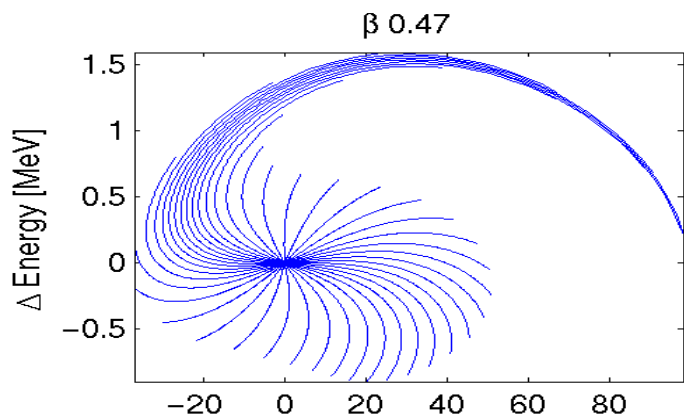
Perfect Beam 2σ



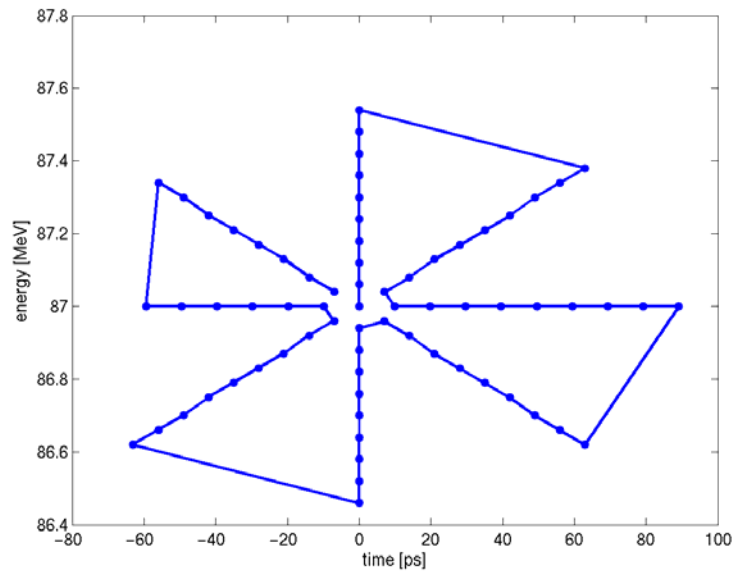
Perfect Beam 4σ



Perfect Beam 6.5σ



Injected Beam



article

Charge according to distance
from center and area covered

$$\sigma_t = 9.9 \text{ ps}$$

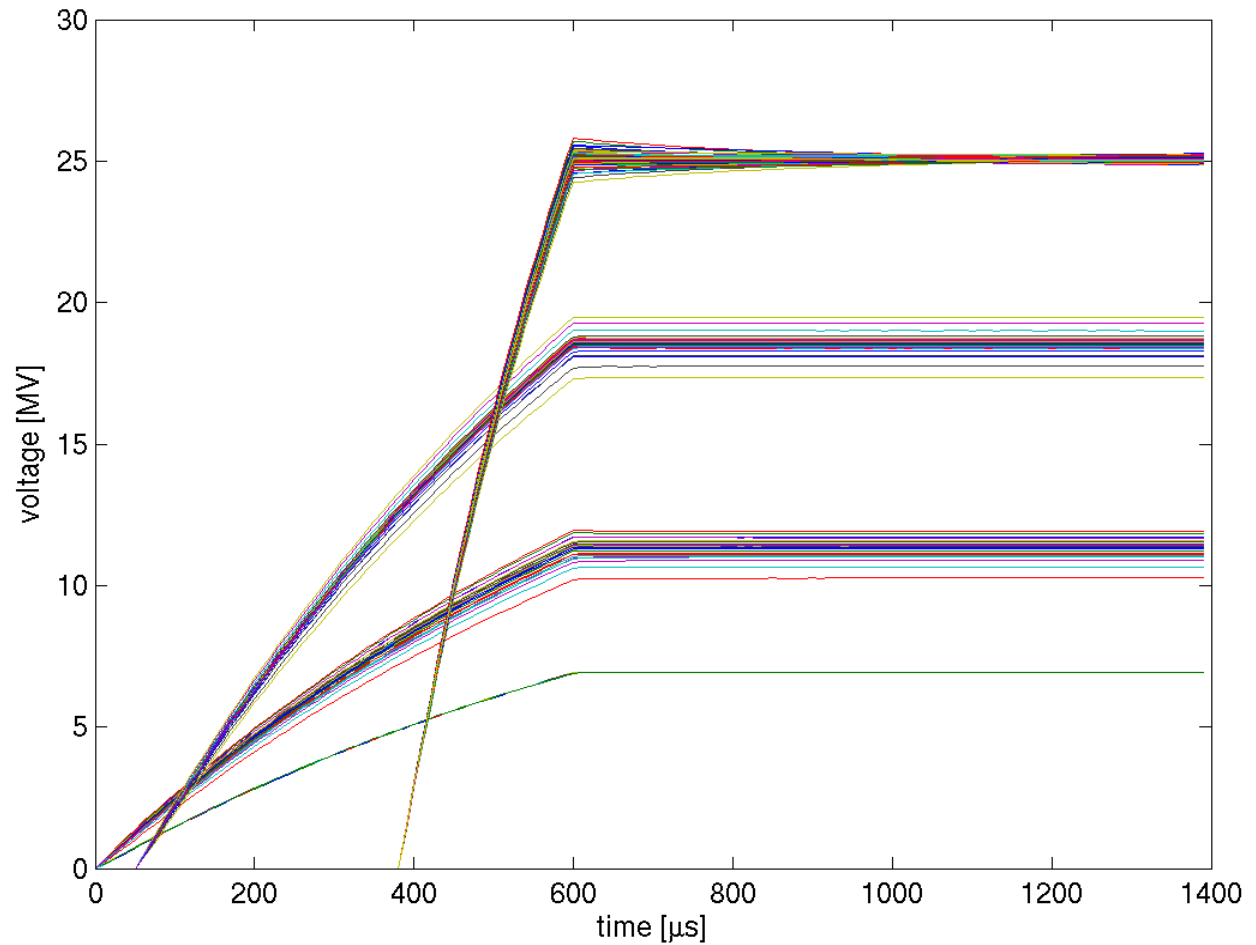
$$\sigma_e = 60 \text{ keV}$$

Centroid jitter:

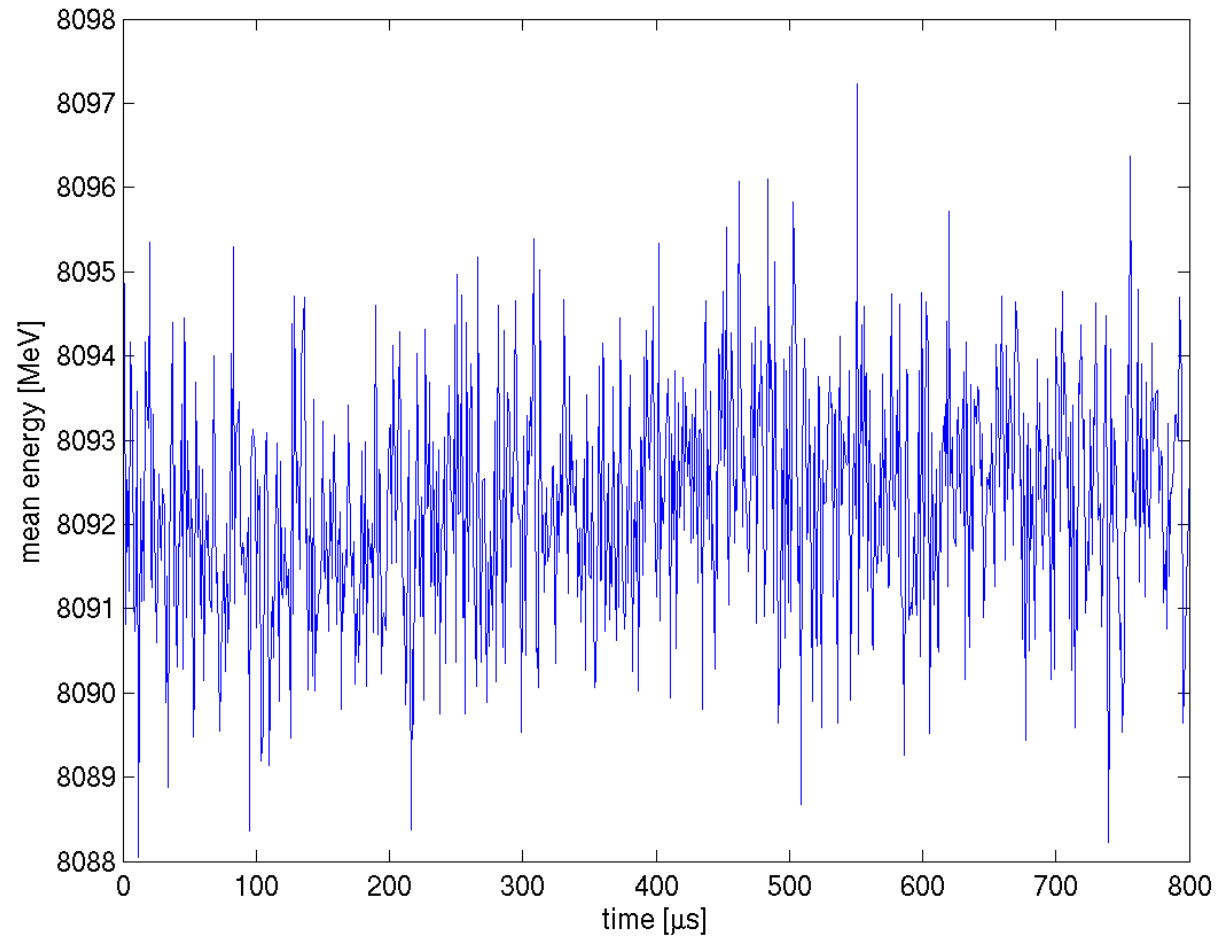
8.2 ps (RMS) (half coherent)

70 keV (RMS) (half coherent)

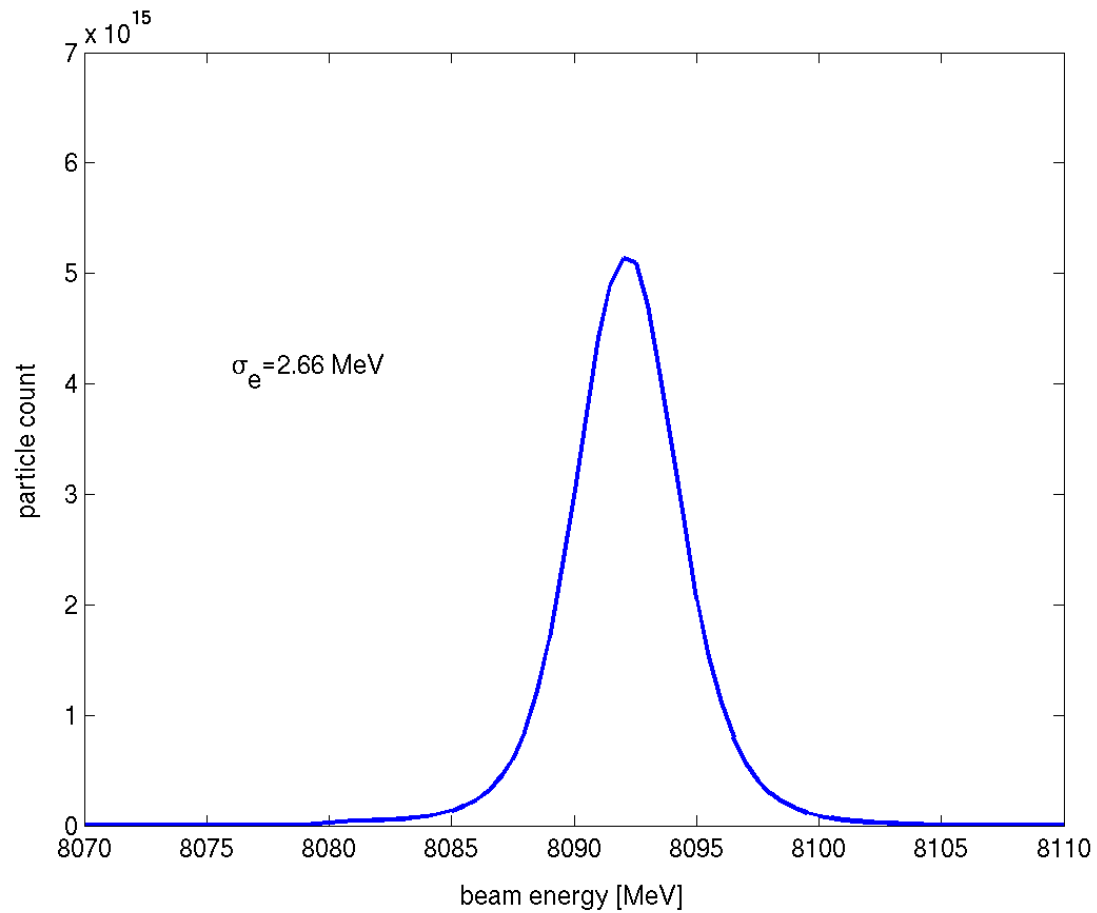
Cavity Fields



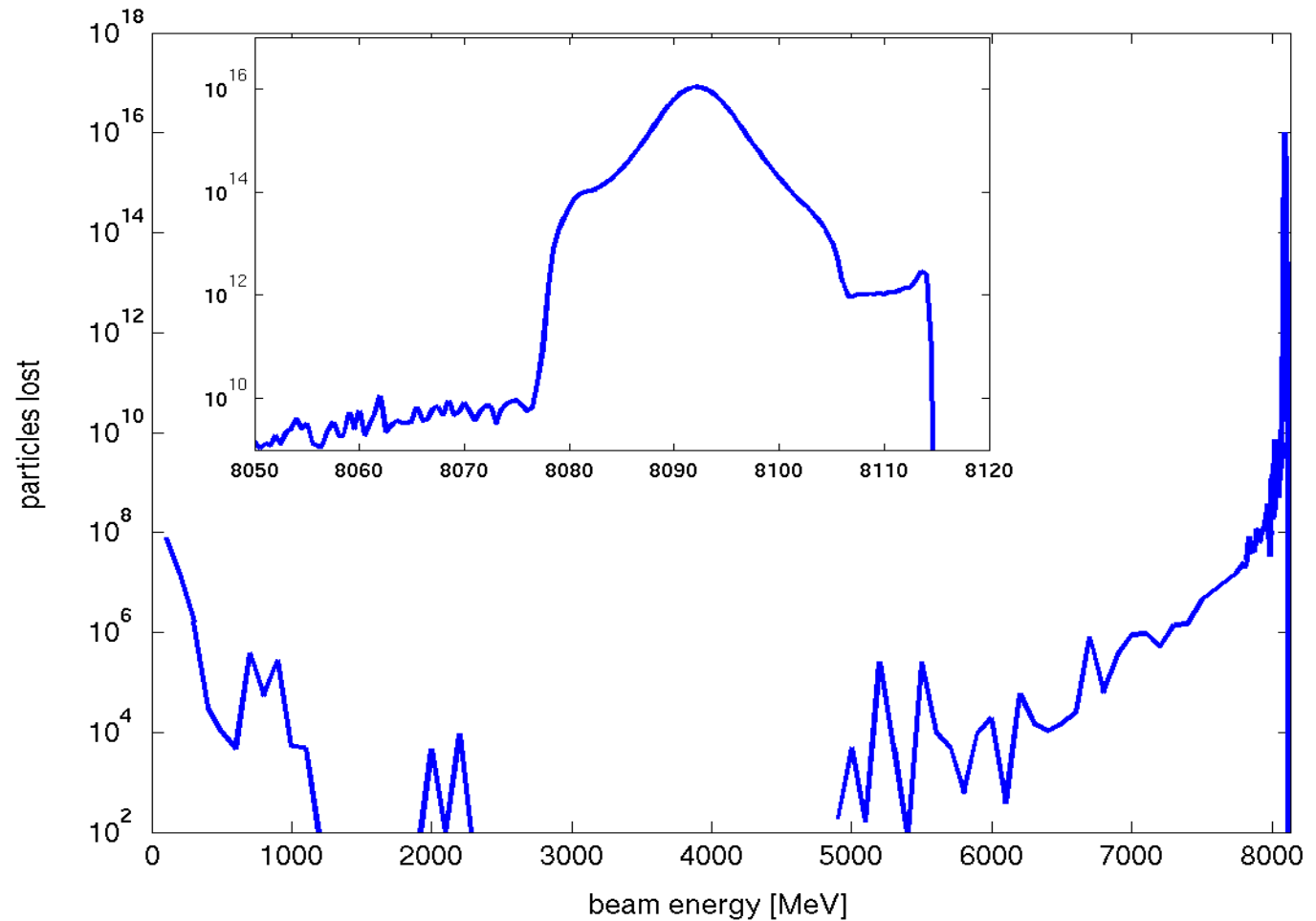
Energy Distribution



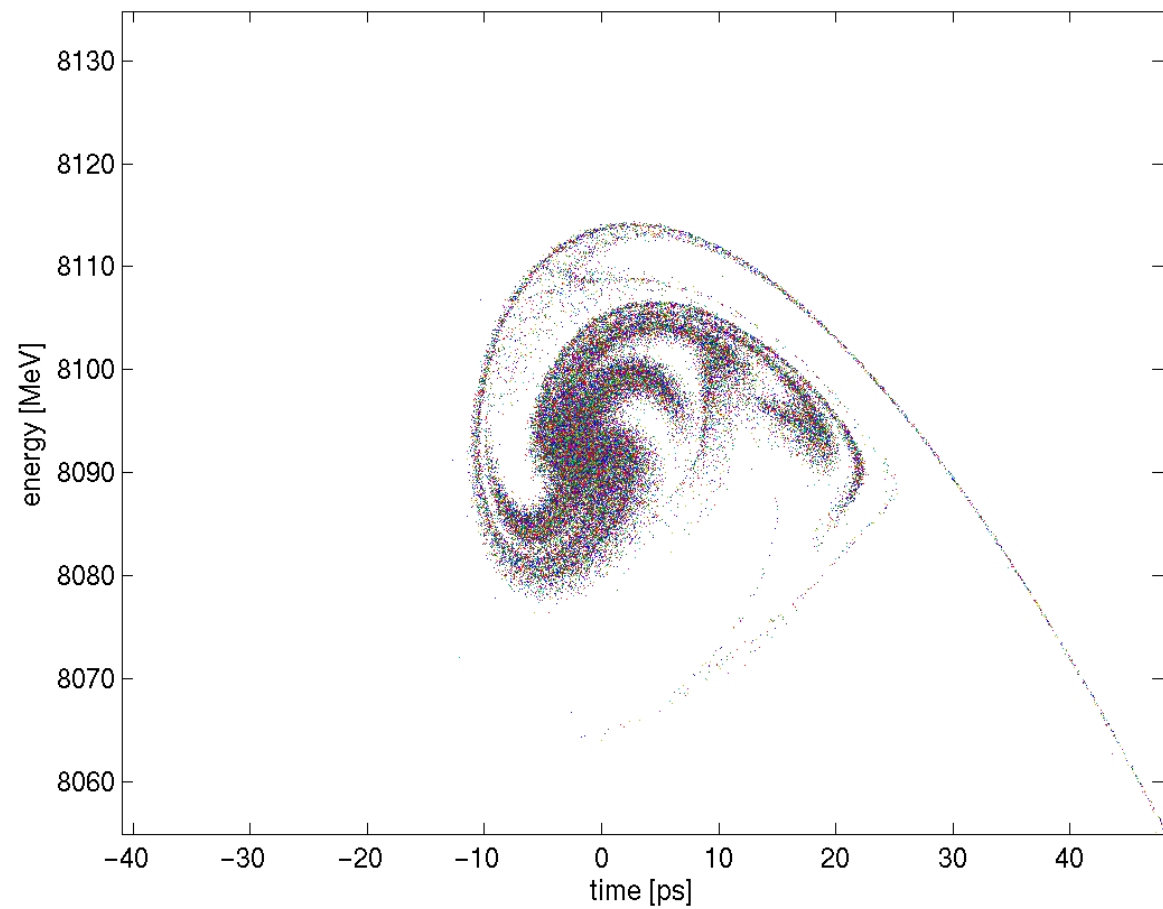
Energy Spread



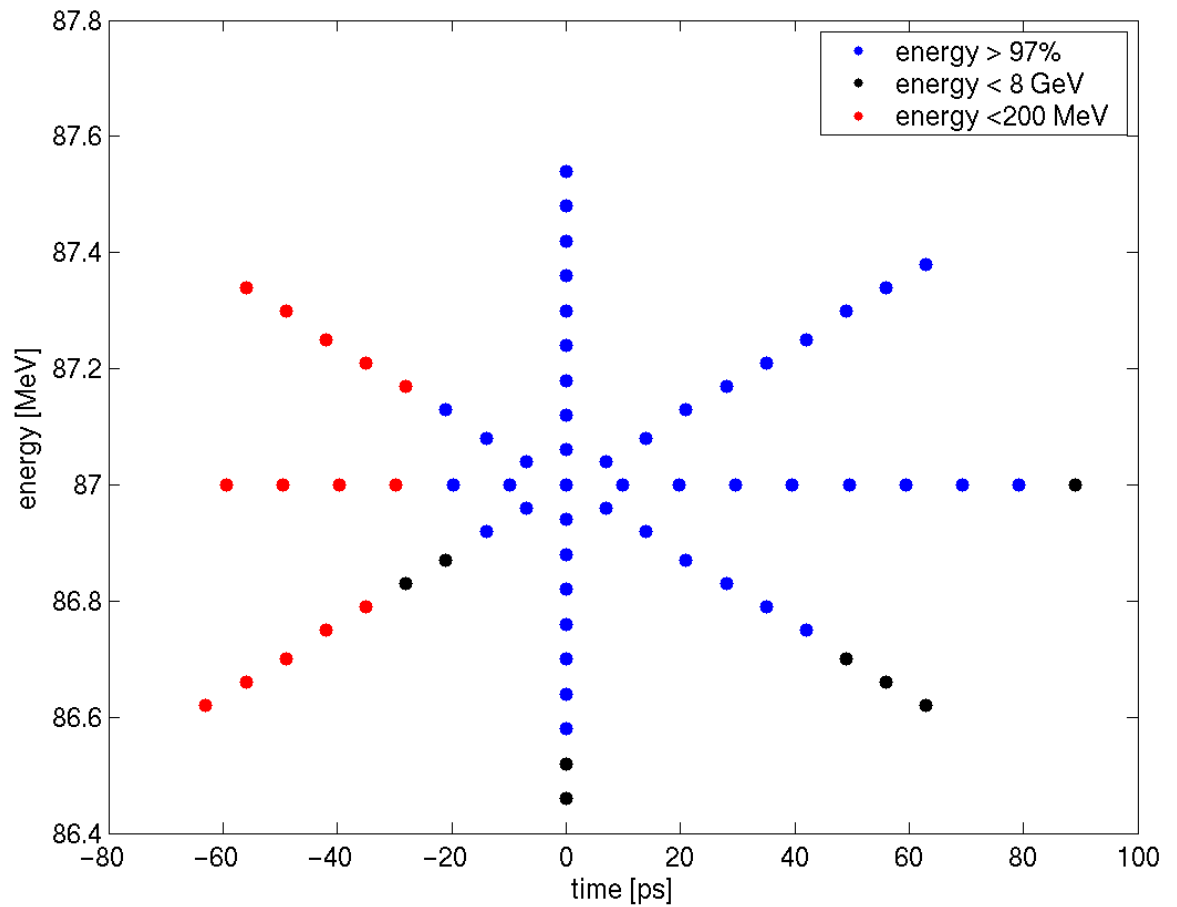
Beam Loss



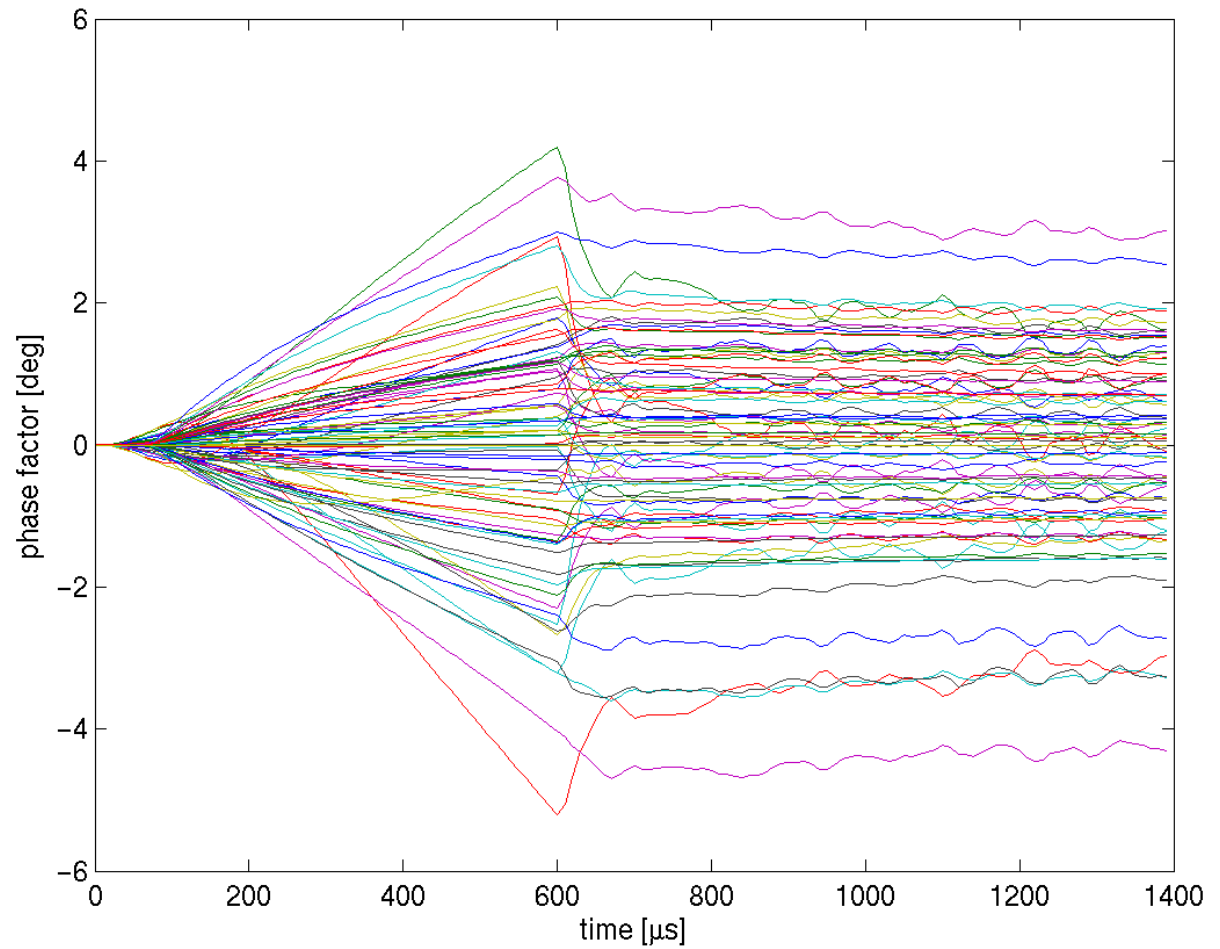
Beam Loss



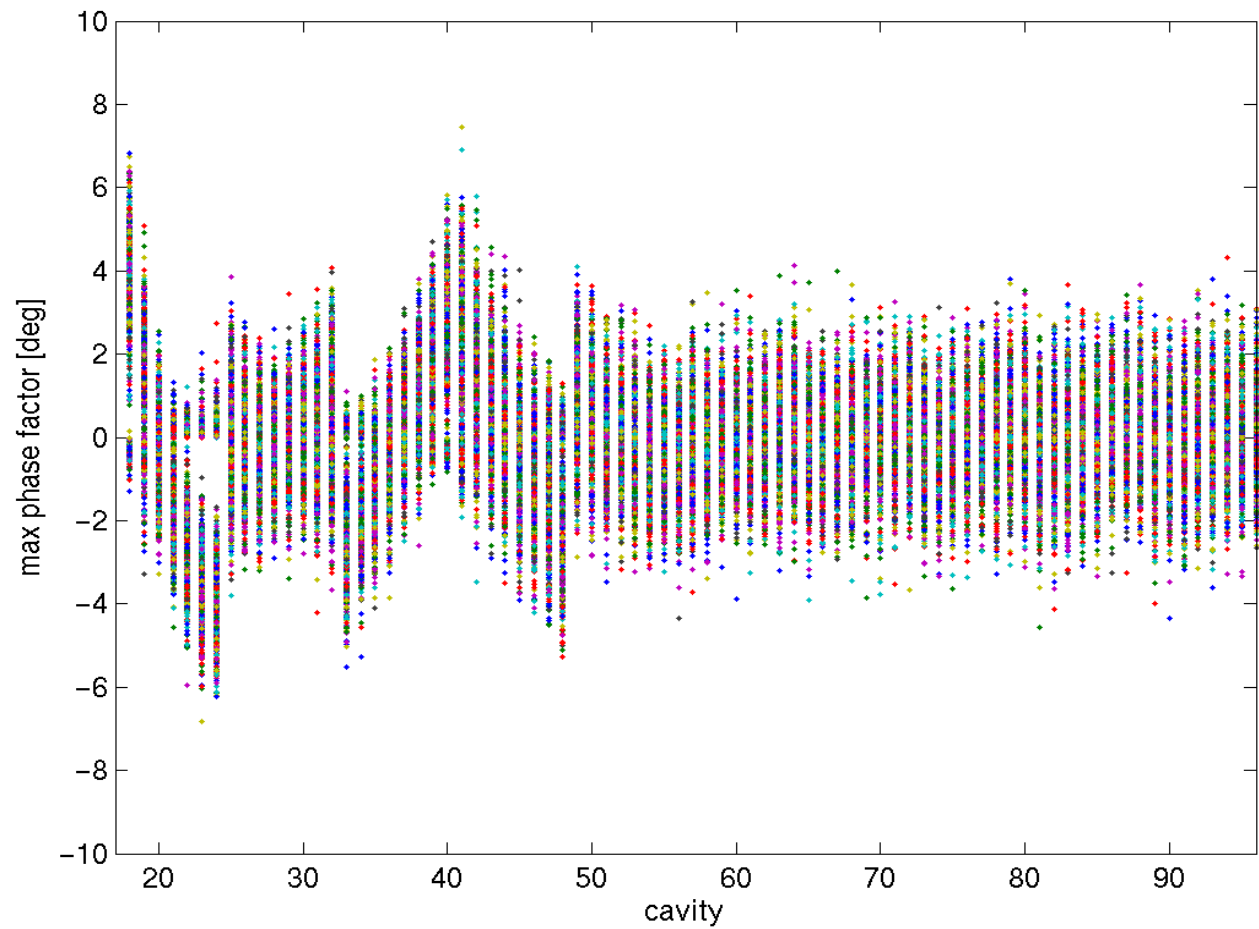
Acceptance



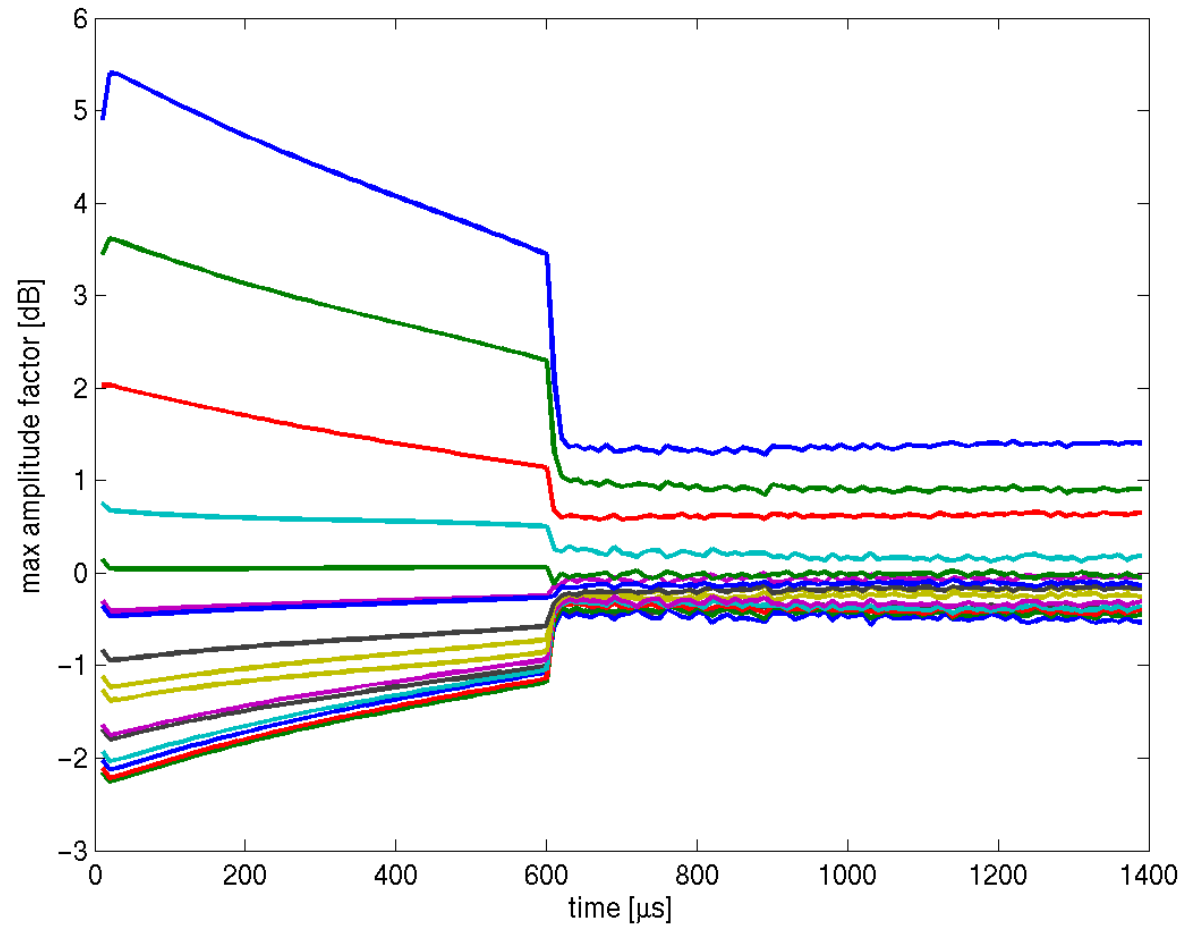
Phase Shifter



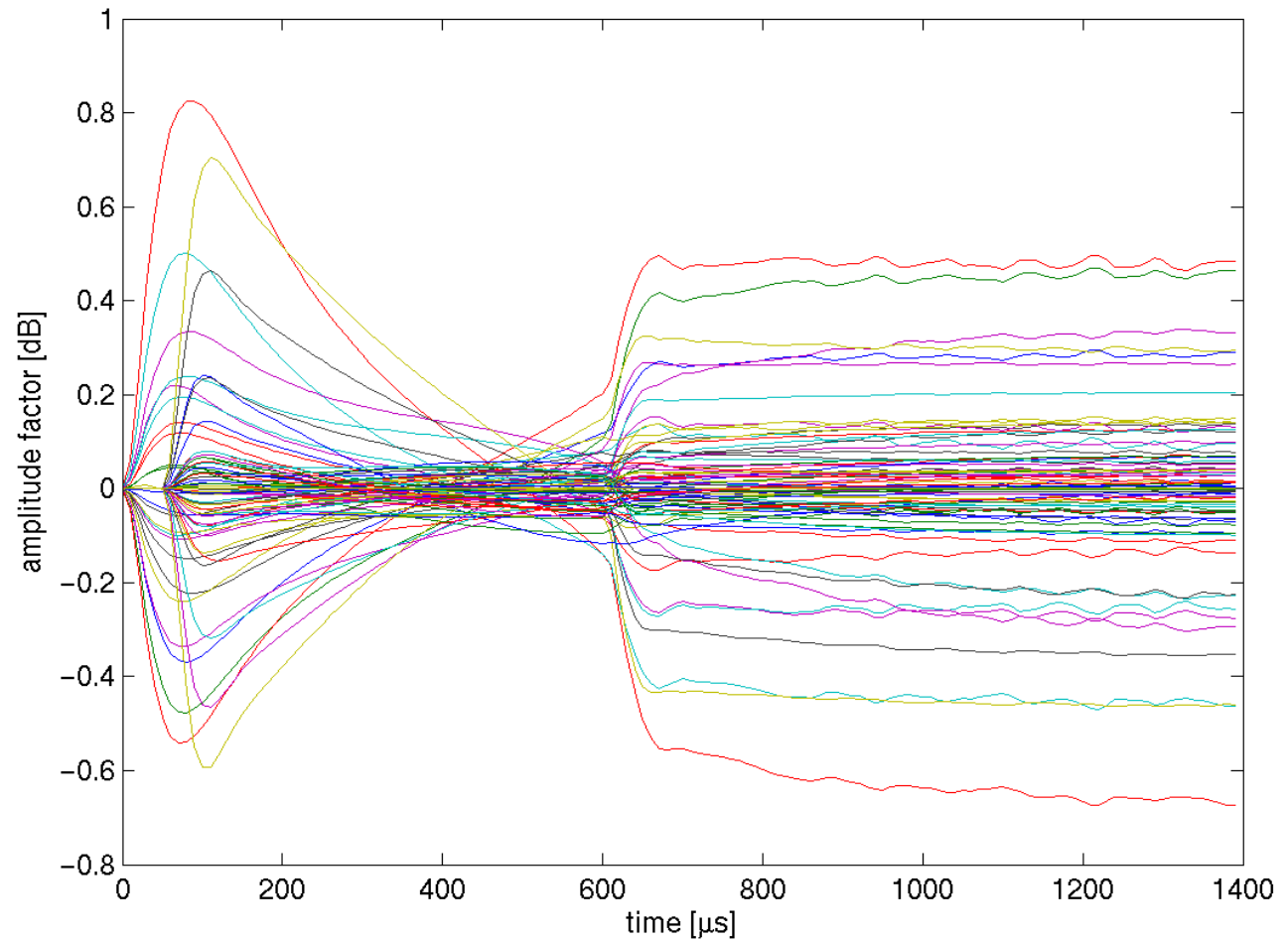
Phase Shifter



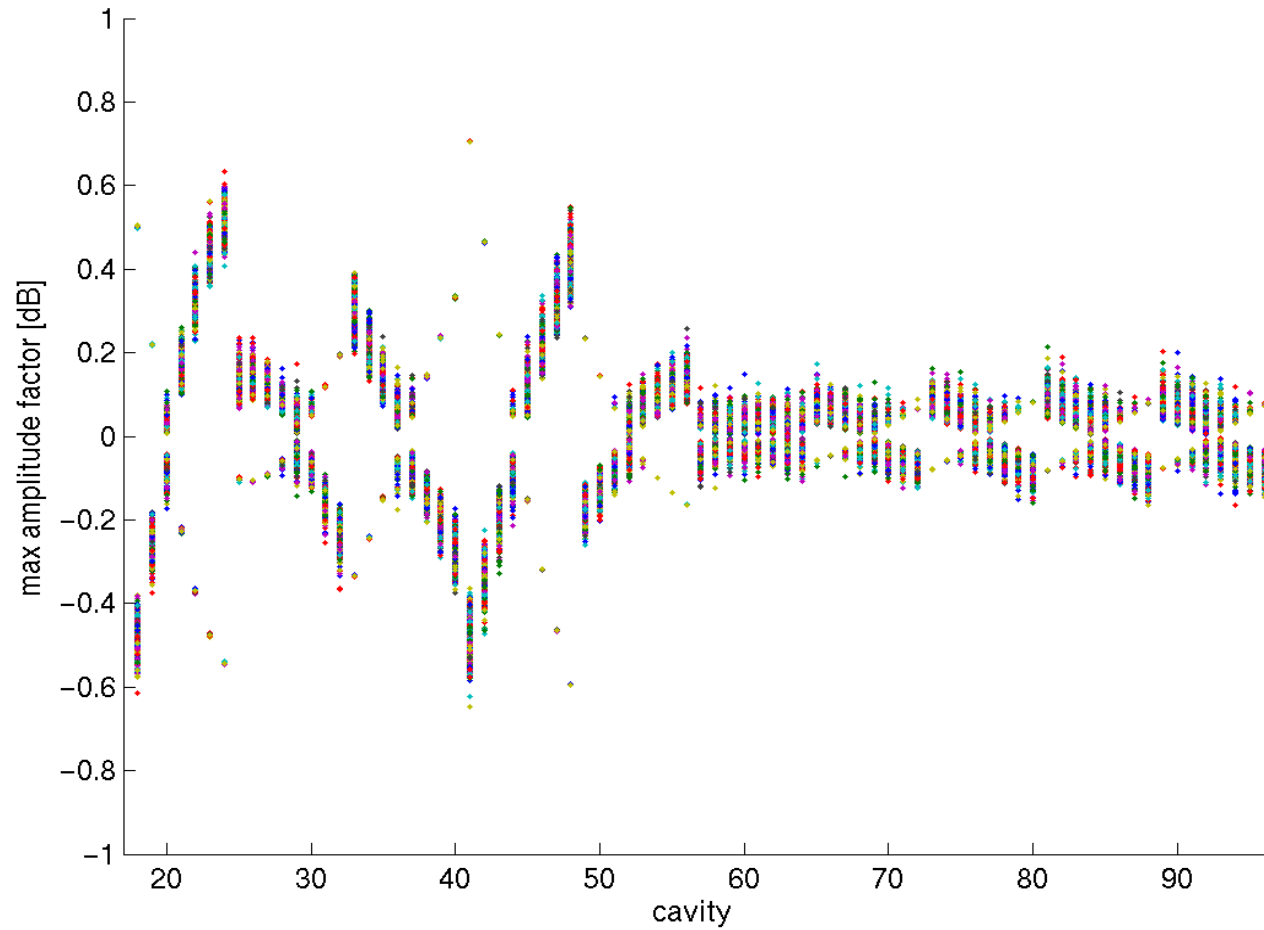
Phase Shifter



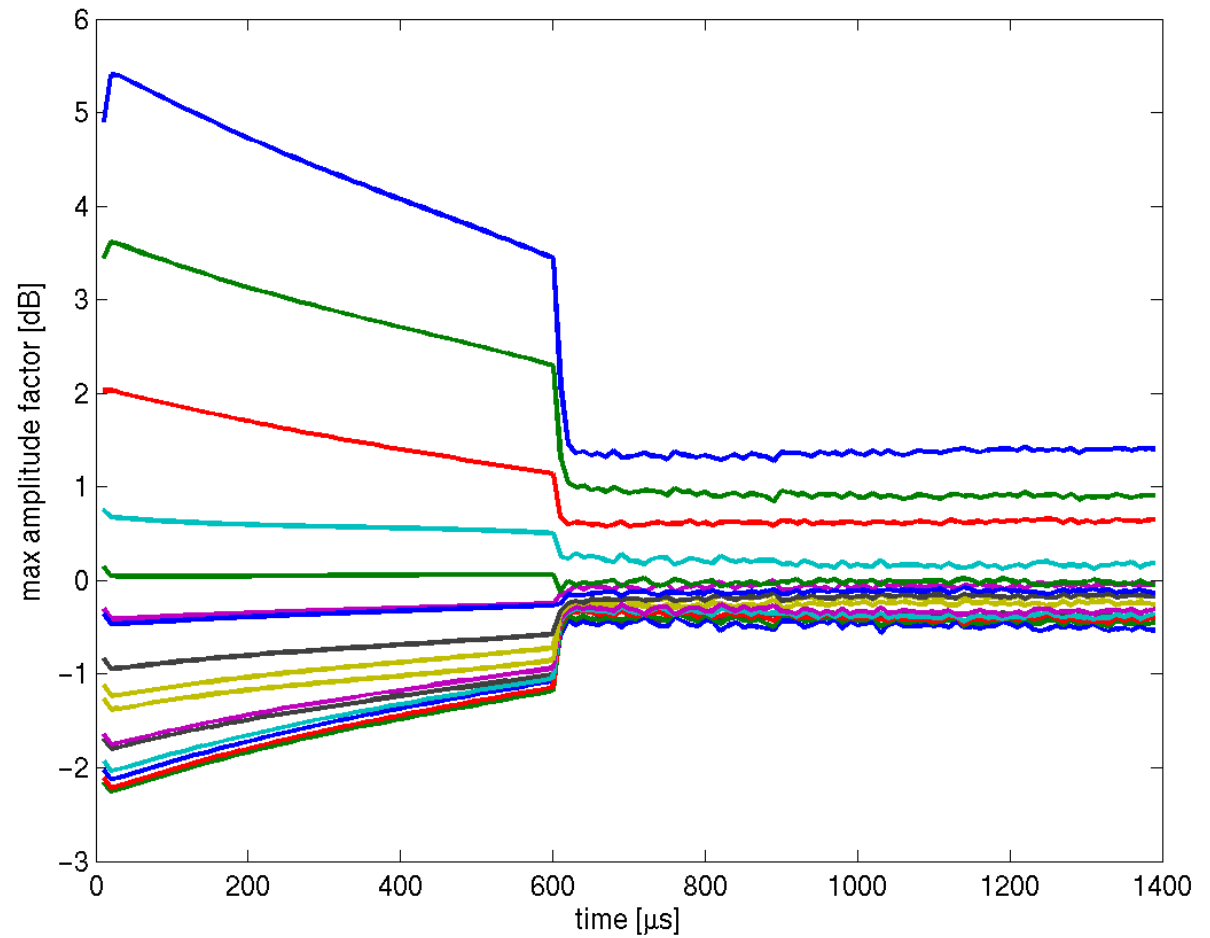
Attenuator



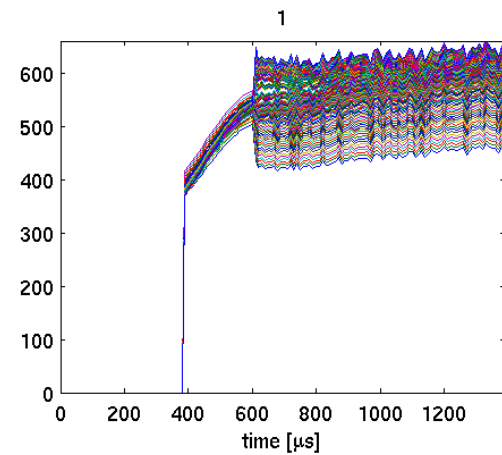
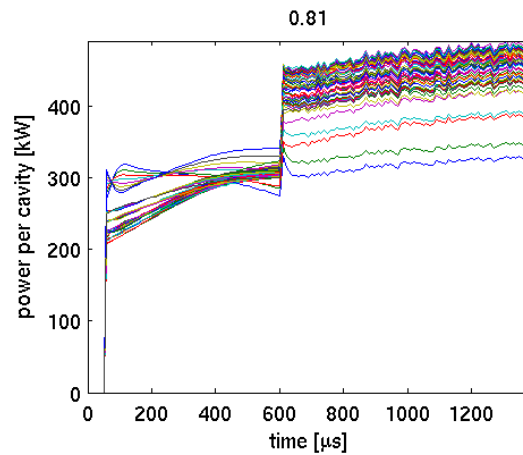
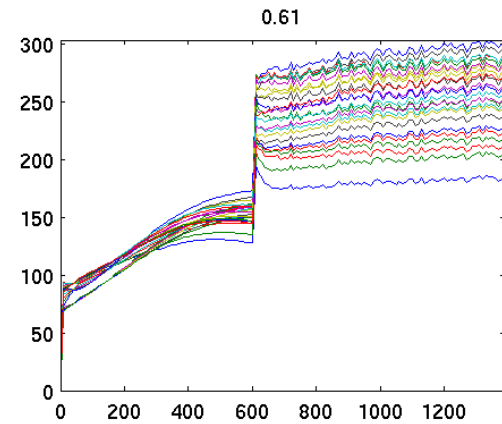
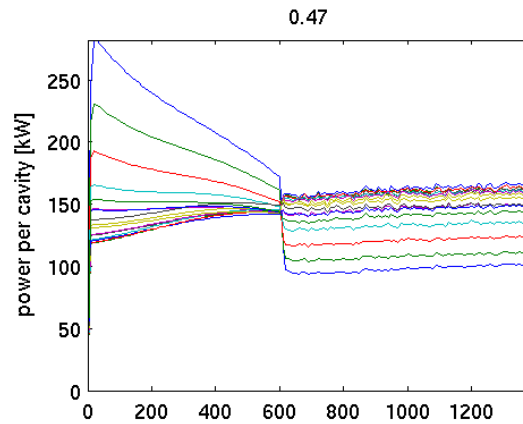
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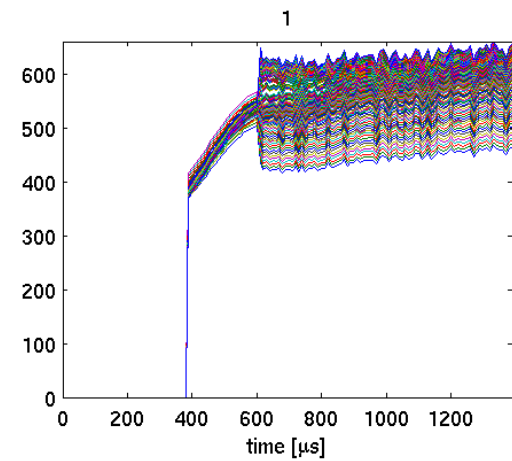
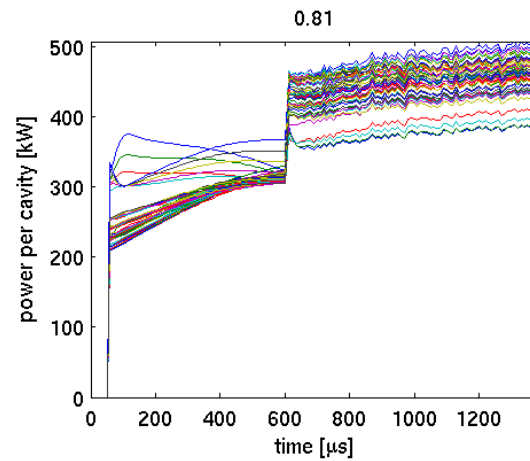
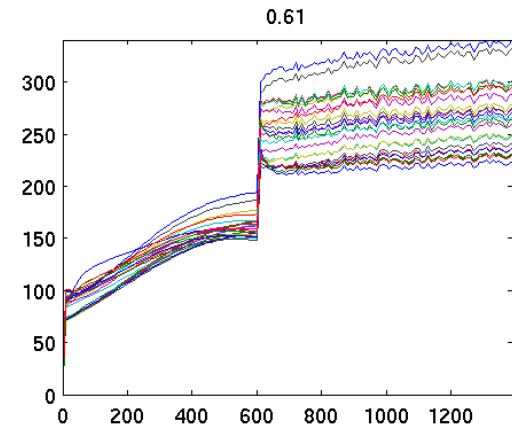
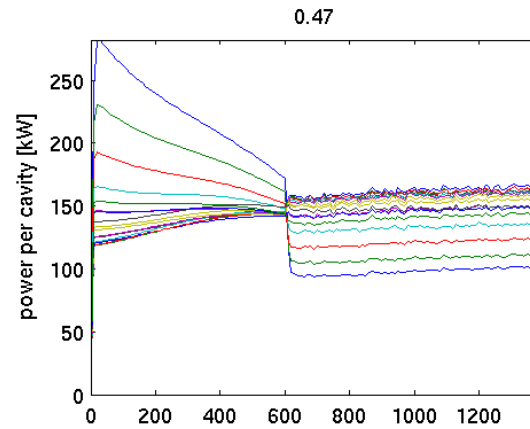
Attenuator



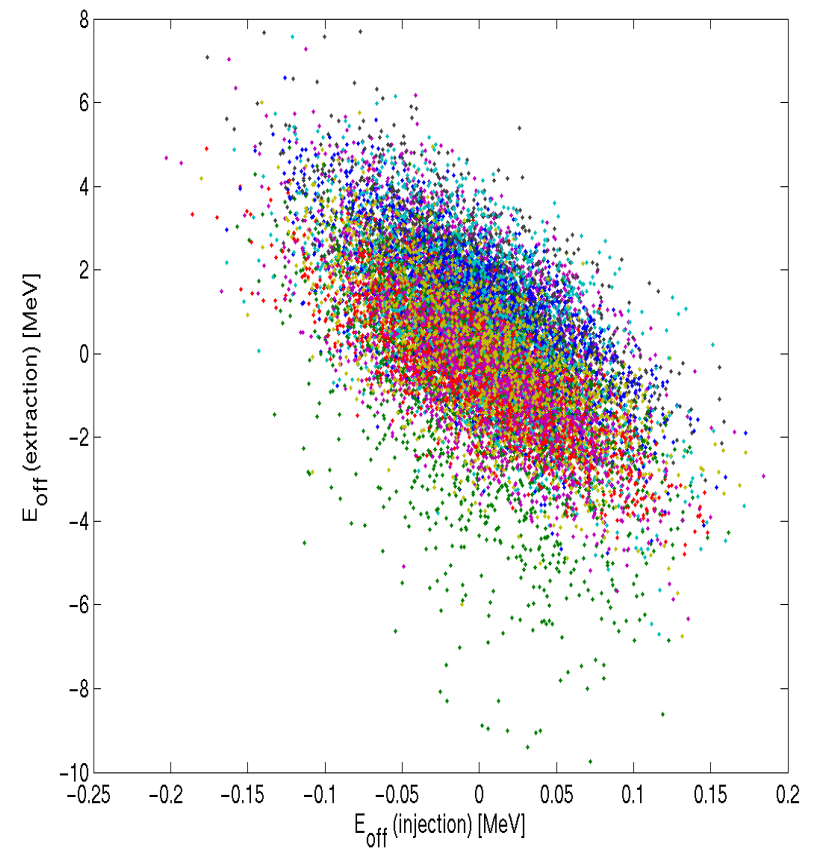
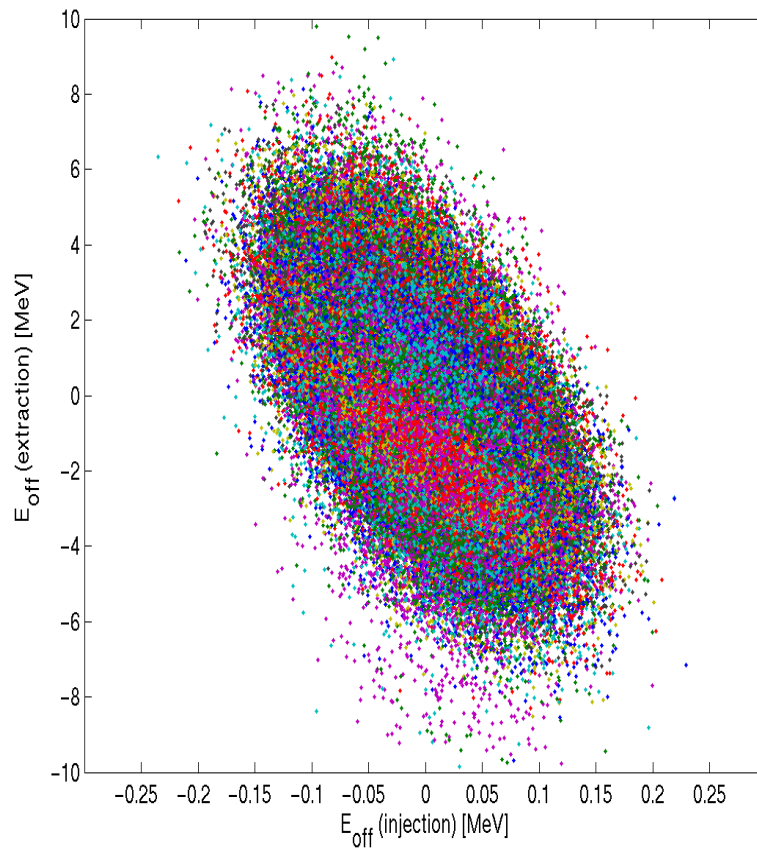
Forward Power



Forward Power

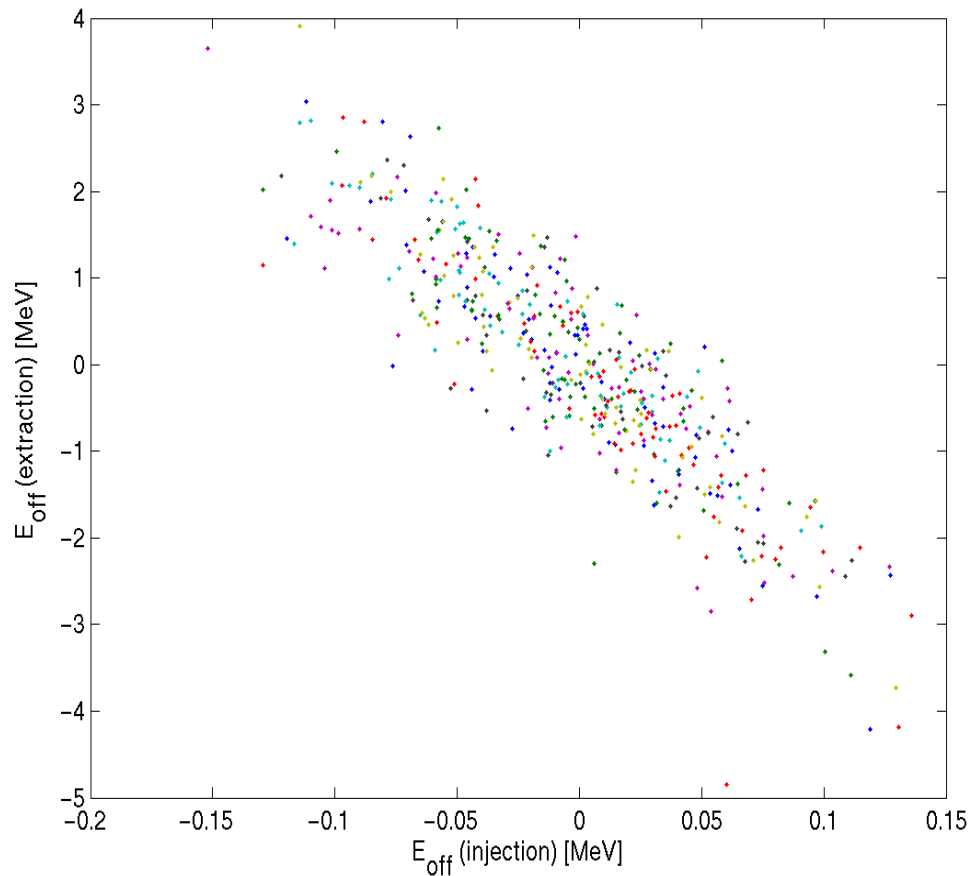


Energy Jitter



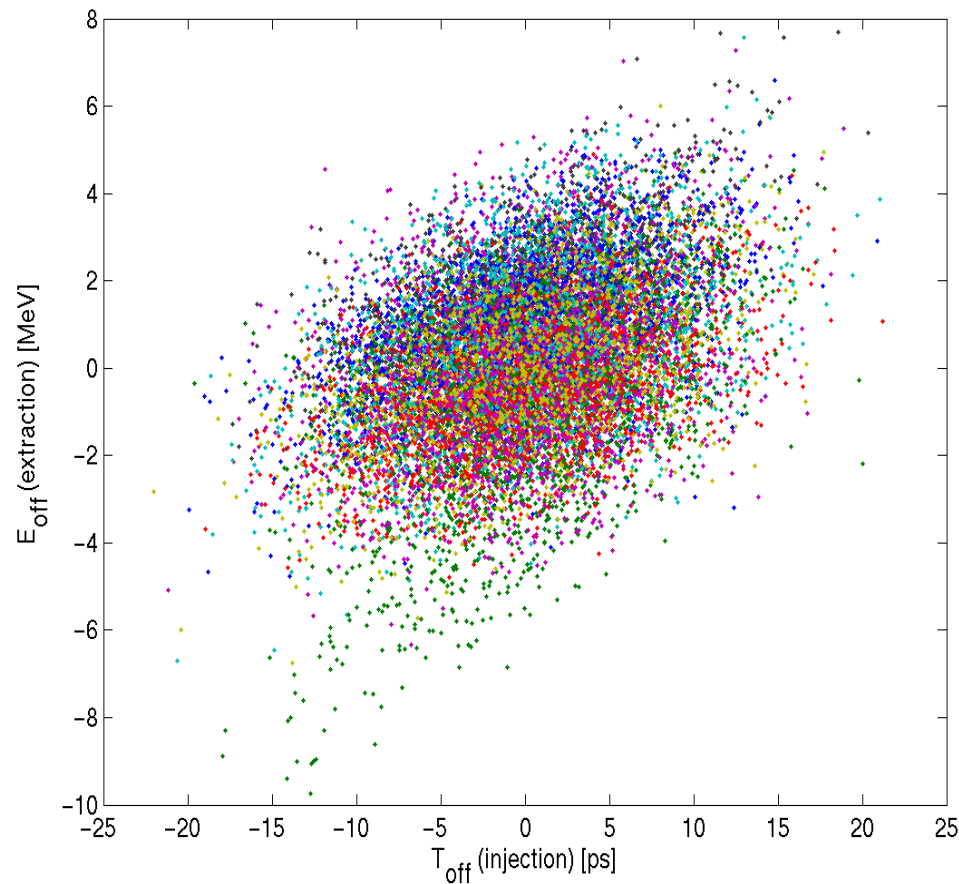
Coefficient: -22.8, \Rightarrow contribution 1.1 MeV (RMS)

Energy Jitter



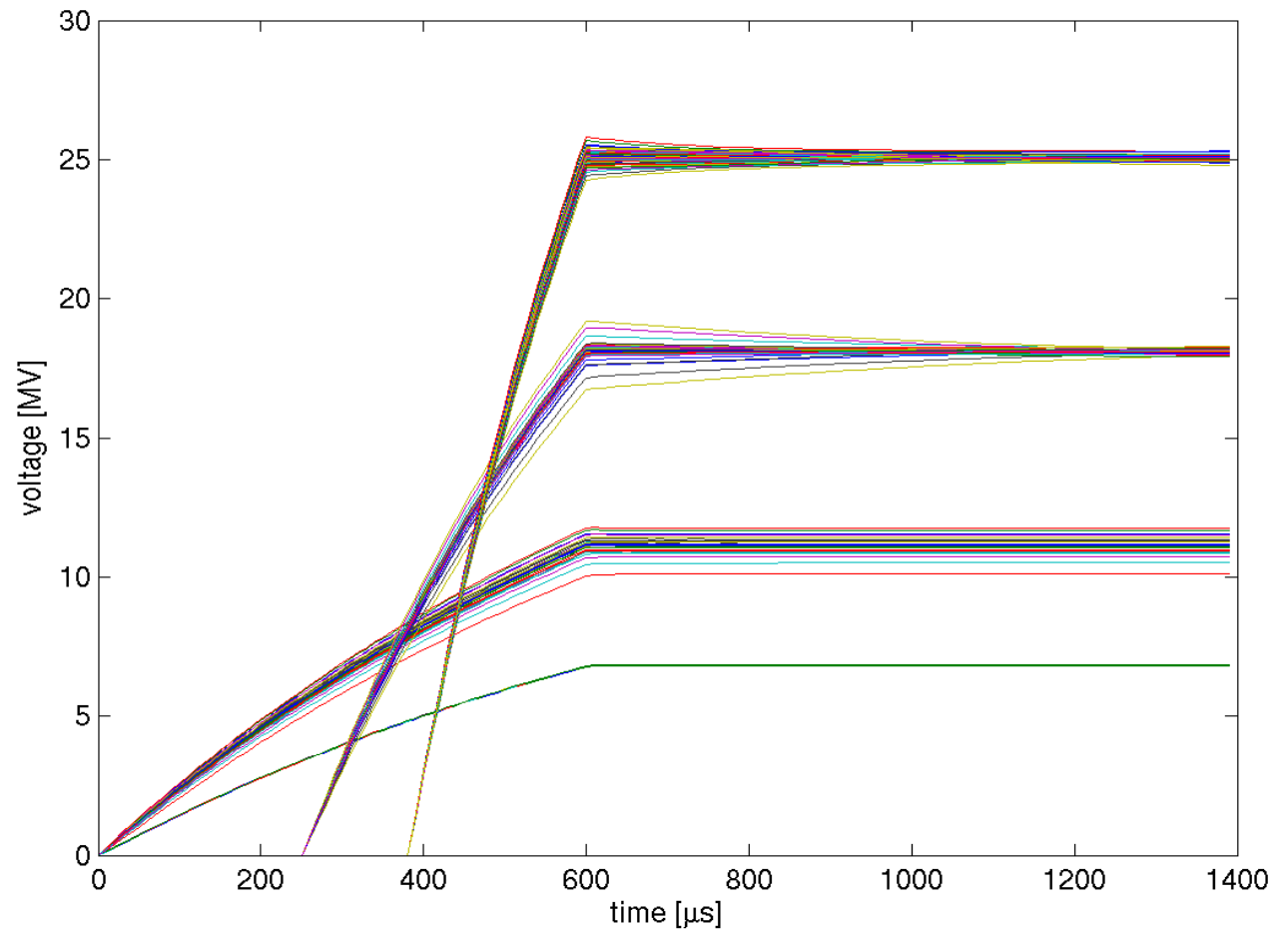
Coefficient -22.0 ,
Contribution 1.1 MeV

Energy Jitter

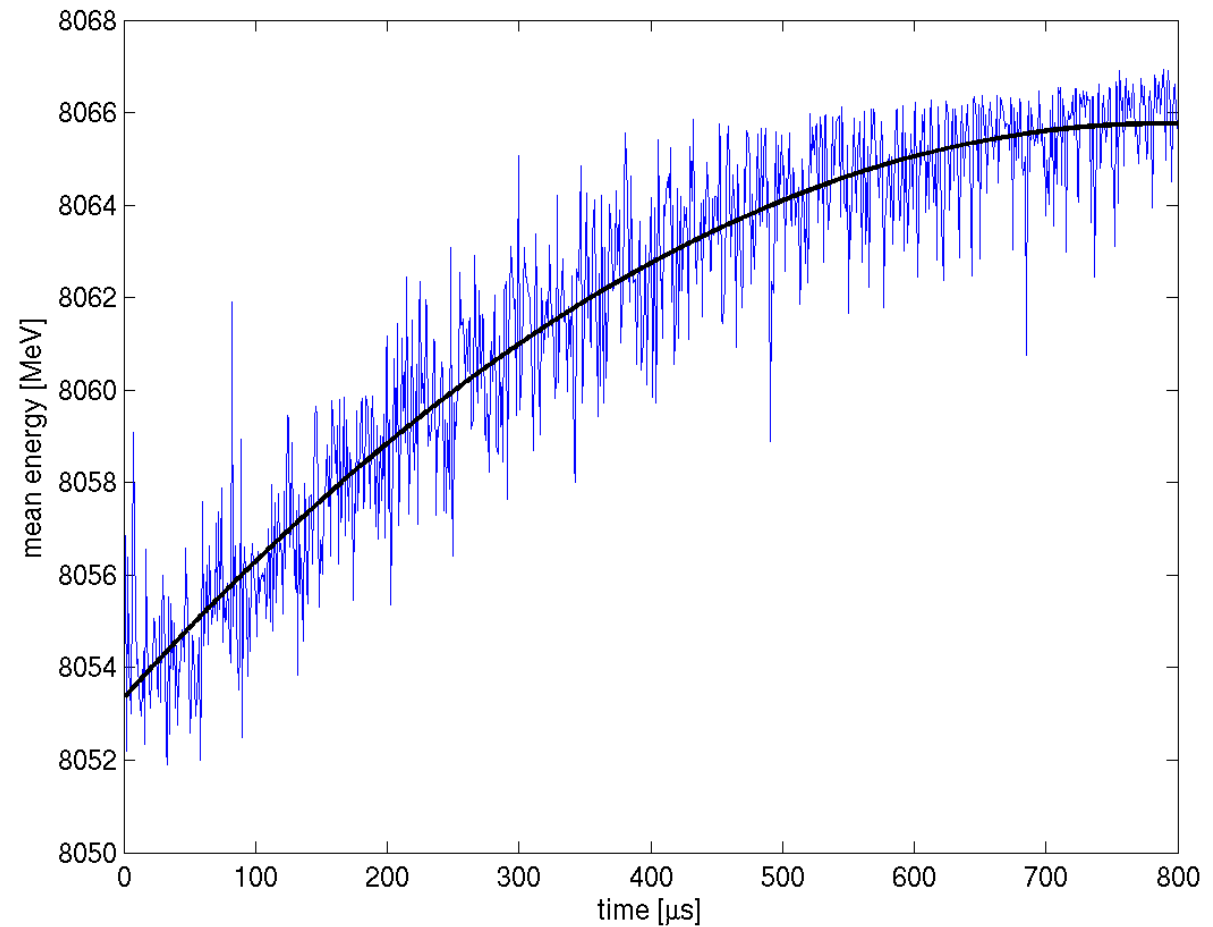


Coefficient 0.13
Contribution 1.0 MeV
(by now the residual
spread is already
imaginary)

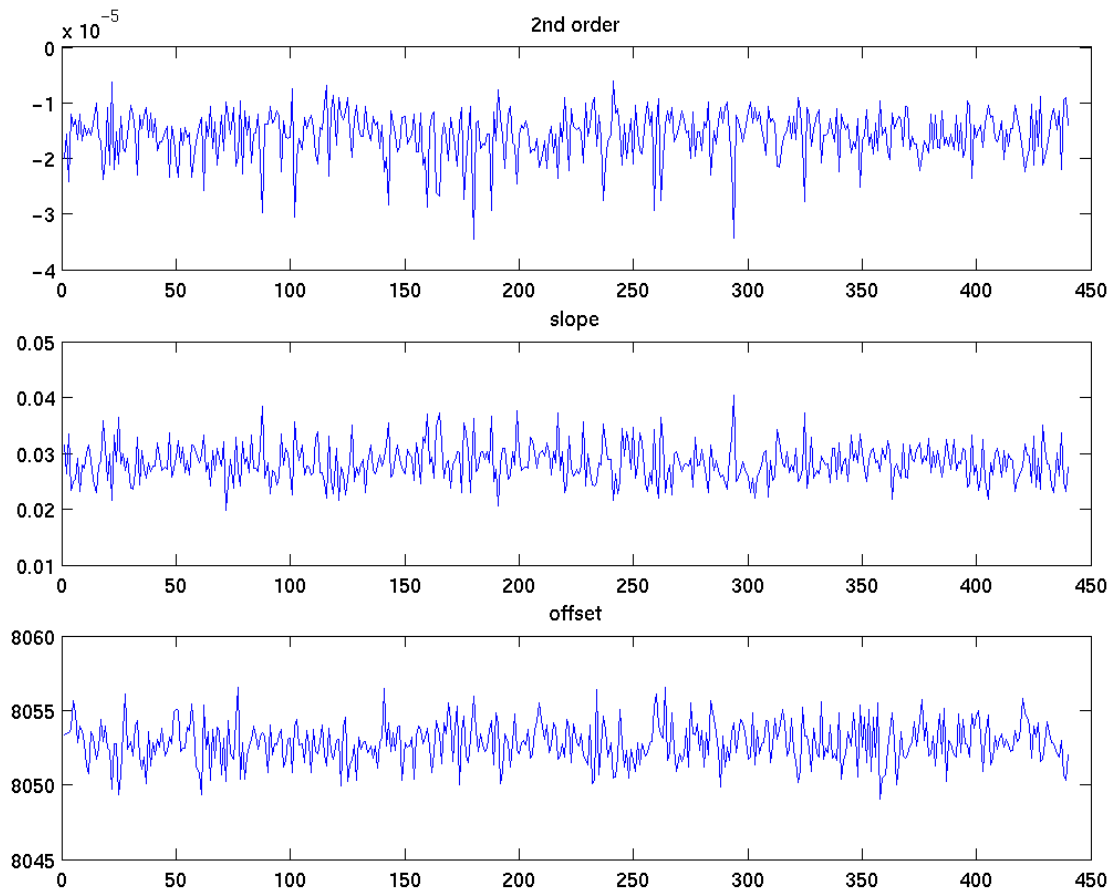
Phase Loop Only ?



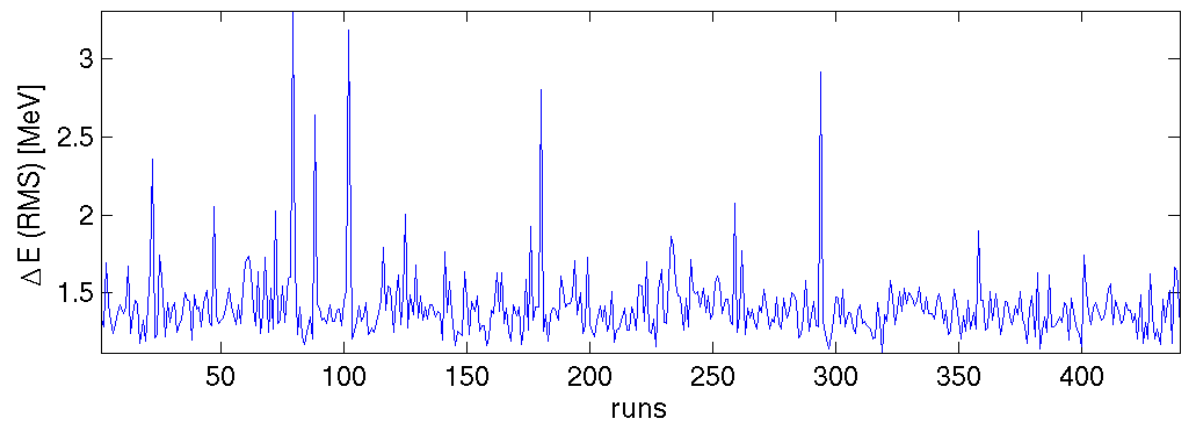
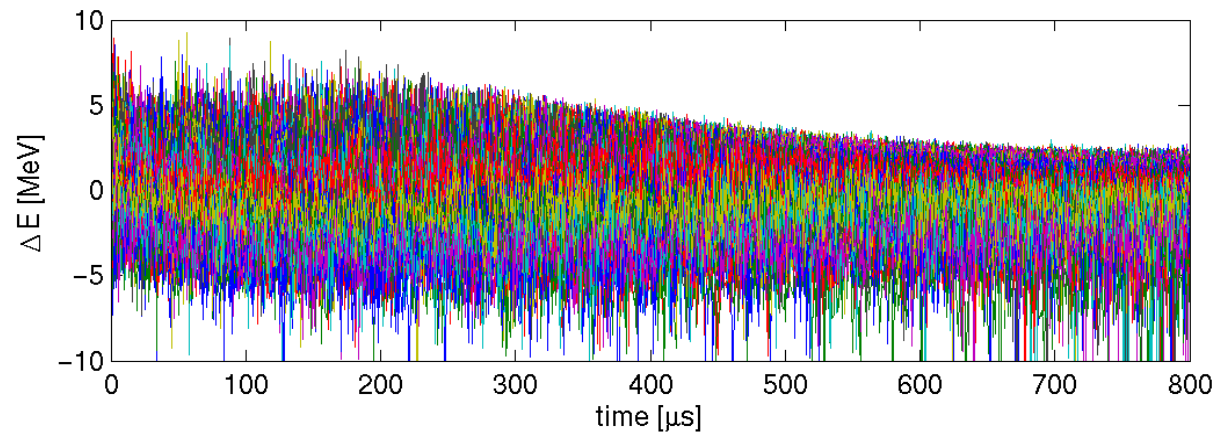
Phase Loop Only



Phase Loop Only



Phase Loop Only



Phase Loop Only?

- With a lot of tweaking it is certainly possible to run the $b=0.81$ section with a phase loop only,
- Main problem (for me) was individual beam loading – but that's systematic (Feedforward)
- Phase corrections the same as above
- Changing operation conditions becomes harder
(beam current, voltages)

Summary

- Vector sum control of the “TESLA” section possible without phasemifter
- Requirements for amplitude correction $< \pm 0.8$ dB (reserve in duration of application)
- Requirements for phase correction $< \pm 8^\circ$ (consider reserve)
- Phase control only operation possible in $\beta=0.81$ section
- Operation with $1/3^{\text{rd}}$ of the current not yet included
- Slightly increased power requirements (excluding insertion losses)